REVIEW

on dissertation work
for the acquisition of the educational and scientific degree "Doctor" in
field of higher education – 5. Technical sciences
professional field – 5.1. Mechanical Engineering
Doctoral program - "Technology of Machine Building"

Author: Eng. Ali Abdulkarim Gitan, MSc
Topic: "Optimization of workpiece positioning during mechanical processing in a CAD environment"

Reviewer: Professor Jordan Maximov, DSc, PhD

1. Relevance and novelty in the dissertation work

In modern machine building, the accuracy of the dimensions of the parts is crucial for the proper functioning of the respective mechanism. To ensure dimensional accuracy, the optimal positioning (basing and fastening) of the workpiece is essential. In this aspect, the work is topical, and the use of a CAD-based approach predetermines the novelty.

2. Cited literature

The list of used literature contains a total of 103 titles (77 are in Cyrillic), which are distributed as follows: 1) in Cyrillic: monographs – 1, books – 27, conference reports – 6, articles – 2, reference books and catalogs – 10 and dissertations – 1, textbooks and teaching aids – 30; 2) in Latin: books – 2, articles – 14, conference reports abroad – 3, and websites – 7.

The articles in Latin are mostly in international scientific journals, among which articles in high-level Elsevier journals such as the International Journal of Machine Tools and Manufacture and the Journal of Materials Processing Technology stand out.

Judging by the literature used, the research on the problem is generally known to the author of the dissertation. On this basis, the author defines the main goal and the tasks to be solved, thus building on what has been achieved so far.

3. Research method

A theoretical-experimental approach was used.

4. Brief description of the material on which the contributions are formulated

Chapter 1 is devoted to an overview of methods for automated design of fixtures for locating workpieces in mechanical processing. Relevant conclusions are drawn and on this basis the goal of the dissertation and the tasks, the solution of which will achieve the goal, are defined.

In *Chapter 2*, a methodology for selecting an optimal scheme for basing and fastening of blanks has been developed. A systematization of the possible schemes for basing of blanks in basing and fastening fixtures has been carried out with the aim of using them for automated design. An approach for selecting an optimal scheme for basing and fastening based on the accuracy and reliability indicators has been proposed. An analysis has been carried out, with the help of which the criteria for geometric compatibility have been defined, allowing the selection of a basing scheme satisfying the geometric shape of the blank. An analysis of the structures of basing elements used in the fixtures has been carried out, on the basis of which the criteria for their selection have been defined. To select an optimal basing and fastening scheme based on the processing accuracy criterion, combinations of workpiece surfaces and basing elements presented as computational modules ("plane-plane", "cylinder-prism", "cylinder-cylinder" and "combined") have been considered, for which dependencies have been derived and block diagrams have been developed for determining basing inaccuracies. Dependencies have been proposed for determining the dimensions of the basing elements depending on the basing scheme. An approach and optimal solutions for selecting a basing and fastening scheme based on the reliability criterion have been proposed, and for several basing and fastening schemes that meet the accuracy and reliability conditions, a methodology for selecting them based on the minimum costs for designing and manufacturing the fixture has been proposed.

In *Chapter 3*, as the main approach to solving the task of automating the selection of an optimal base and fastening scheme, the systematic approach is adopted, allowing the task to be divided into separate stages in order to highlight the connections between them and the criteria for optimal search. A general model of the automated system for selecting an optimal base and fastening scheme for blanks using CAD systems is proposed and the necessary database is specified. Through a joint analysis of the theoretical base and fastening scheme and the geometric shape of the blank, an algorithm has been developed for forming possible base and fastening schemes and calculating the inaccuracy of the base. Algorithms have been developed for: selecting the design of the base elements and determining their dimensions; determining the inaccuracy of fastening; determining the dimensional wear of the base elements and checking reliability. For the final selection of a base and fastening scheme based on the criterion of minimum costs for the design and manufacture of the device, an algorithm and automated tables have been developed, shown in the appendix.

In *Chapter 4*, models for the operation of the automated system for selecting the optimal foundation and fastening scheme are developed in the form of class and state diagrams, as well as a structural diagram of the software package that can be used to develop a computer program. For the software implementation of the automated system, a database of solid-state models of foundation elements in the SolidWorks environment and tables for automated selection of their parameters in the MSExel environment given in the appendix have been developed. A methodology for the practical implementation of the automated system for selecting the optimal foundation and fastening scheme has been developed, which is verified with an example given in the appendix to the dissertation work.

5. Contributions of the dissertation work

Regardless of the author's view, I have edited, summarized, and classified the contributions as follows:

A. Scientific-applied contributions

A.1. Creation of new classifications, methods, constructions, models, methodologies, algorithms

▪ Systematization of possible basing schemes.

▪ Models, methodology, algorithms, criteria and diagrams of classes and states for the selection, construction and development of a computer program for the selection of an optimal foundation and anchorage scheme.

A.2. Obtaining and proving new facts

There is none.

A.3. Obtaining corroborating facts

There is none.

B. Applied contributions

• Structural diagram of a software package for selecting the optimal scheme for basing and fastening.

• Database with solid-state models of basing elements.

• Tables for: selection of basing element models; preliminary assessment of the economic efficiency of the designed fixtures.

6. Publications on the dissertation

The author has published a total of 5 scientific papers on the topic of the dissertation as follows:

1) Scientific conferences in Bulgaria – 2 reports;

2) Scientific conference abroad (Rēzekne, Latvia) – 1 report;

3) Journal "Машиностроене и машинознание" – 2 articles.

Two of the publications are independent.

Based on the above data, it can be concluded that the results of the dissertation of Eng. Ali Gitan have been disseminated and discussed sufficiently well.

7. Notes on the dissertation

The dissertation is well structured and written. The research conducted is sufficiently in-depth. I have no remarks of a fundamental nature.

8. Other questions

I believe that the educational function of doctoral training has achieved its goal. The doctoral student has significantly increased his knowledge in the field of Machine Building Technology.

9. Conclusion

I believe that the presented dissertation work "Optimization of workpiece positioning during mechanical processing in a CAD environment" with the author mag. eng. Ali Abdulkarim

Gitan meets the requirements of the Act on the Development of Academic Staff in the Republic of Bulgaria. The achieved results give me reason to propose to the esteemed scientific jury to award the educational and scientific degree "Doctor" to Ali Abdulkarim Gitan, in the field of higher education 5. Technical sciences, professional field 5.1. Mechanical engineering, doctoral program "Technology of mechanical engineering".

22.07.2025   Reviewer:

Gabrovo   Professor Jordan Maximov, DSc, PhD